

# Improving Solid Waste Management at Aktubinsk Ferroalloys Plant



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**Project Title:** Development of Integrated Solid Industrial Waste Management System at Aktubinsk Ferroalloys Plant

**Project Leader:** Aktubinsk Ferroalloys Plant, Aktubinsk, Kazakhstan

**Project Partner:** EnSafe, Inc, Memphis, Tennessee, USA

**Location of Project:** Aktobe, Kazakhstan

**Project Duration:** January 2002-November 2002

**EcoLinks Project Contribution:** Total Project Investment: \$79,508; EcoLinks Grant Support: \$43,758; Project Team Cost-share Contribution: \$35,570.

## Best Practice: Transferable Solutions

The project "Improving Solid Waste Management at Aktubinsk Ferroalloys Plant" is an EcoLinks Best Practice. Through this EcoLinks funded project, one of Kazakhstan's largest ferroalloys producers, Aktubinsk Ferroalloys Plant (AFP), teamed with a US consulting firm, EnSafe, to develop alternatives for treating and utilizing slag waste. Project results demonstrated that by making inexpensive modifications to the smelting process, the future slag waste stream stored at AFP can be reduced by 70%, while earning the company over \$110,000 annually in gravel sales. Project recommendations on modifying the smelting process and stabilizing slag waste can be transferred to other ferroalloys producers in the NIS.

## Project Summary

Aktubinsk Ferroalloys Plant (AFP) produces ferrochrome and other alloys used in the production of high quality steel. Solid slag waste is a byproduct of ferrochrome production. Nearly 220,000 tons of slag waste is generated each year from low-carbon ferrochrome production at AFP facilities. Prior to project implementation, most of this low-carbon slag waste was simply stored on-site. AFP has been in operation since 1943 and current on-site waste storage has reached over 12,000,000 tons. Low-carbon slag waste is classified as a third-class hazardous waste, containing carcinogenic substances such as hexavalent chromium. Since

AFP facilities are located within Aktubinsk city limits, storage of low-carbon slag waste represents both an environmental and a public health risk.

Through this EcoLinks funded project, the Aktubinsk Ferroalloys Plant (AFP), teamed with an American environmental consulting organization, EnSafe, to develop and implement improvements in AFP's solid waste management practices, focusing on low-carbon slag waste in particular. The project team first conducted an assessment of solid waste production, handling and storage at AFP facilities. Results of this assessment showed that low-carbon slag waste is AFP's most problematic waste stream, due to its volume and toxicity. Impacts of exposure to low-carbon slag waste were evaluated and pathways of exposure identified. Next, alternative processes in the smelting process and uses for slag-waste were developed and ranked according to economic and environmental attractiveness. An optimal alternative was selected and pilot tests were conducted on the chosen alternative. Finally, results of the project were presented at a conference on solid waste management. Project results demonstrated that by making inexpensive modifications to the smelting process, the future low-carbon waste stream stored at AFP can be reduced by 70%, while earning the company over \$110,000 annually in gravel sales.

## **Project Activities**

The main goal of this project was to improve solid waste management practices at AFP, with a focus on low-carbon slag waste in particular. Project Activities included the following:

### **1. Assessment of Waste Streams at AFP: Waste Generation, Storage and Disposal**

Action: An initial, over-all assessment of waste stream generation in the production processes, and the handling and storage of wastes at AFP was conducted. The main waste streams at AFP include scrap metal, domestic waste, low, medium and high carbon slag waste, fuel oil and crushed rock. This initial analysis determined that low-carbon slag waste is the most problematic waste stream for AFP due to its volume (218,600 tons generated per year), high metal content and physical properties.

A more in-depth analysis on the slag waste stream was conducted. In the process of smelting, low-carbon ferrochrome decomposes into a fine powder dust. Over 200,000 tons of this low-carbon slag waste are generated at AFP each year. This substance is classified as a third class hazardous waste. It is easily eroded by wind/rain and can contaminate air, surface and groundwater. The fineness of the grains makes it very susceptible to leaching. About 85% of low-carbon slag waste generated at AFP is transported by truck from production facilities to an onsite, out-door dump. The slag dump-pile was started in 1950 and currently covers over 475 hectares.

Product(s): 1) Volume, composition, handling and storage of waste streams at AFP facilities determined.

### **2. Low-Carbon Slag Waste Impacts: Development of a Model of Environmental Risk**

Action: Laboratory analysis was conducted to determine the physical and chemical properties of low-carbon slag waste generated at AFP. AFP's low-carbon slag waste is mostly made up of calcium oxide (48%) silicone dioxide (25%) and manganese oxide (11%). Iron, aluminum, sulfur and chromium make up the remaining 16%.

On-site environmental impacts and public health data of Atkubinsk Oblast were also assessed. The assessment of conditions at AFP showed some wells were contaminated with heavy metals and also that the ground water under the slag disposal area is contaminated with hexavalent chromium. Public health data show reported illnesses on the rise, with respiratory and nervous system disorders the two most commonly reported illnesses.

A conceptual model of exposure pathways to low-carbon slag waste generated at AFP was developed. The model shows potential exposure pathways via inhalation of airborne dust from AFP's on-site waste piles and ingestion risk through contaminated ground water.

Product(s): 1) Physical properties of low-carbon slag waste generated at AFP determined. 2) Environmental and public health impacts reviewed. 3) A conceptual model of potential exposure pathways developed.

### **3. Analysis and Development of Recommendations on Low-Carbon Slag Waste**

Action: The project team developed five potential alternative uses for low-carbon slag waste, based on USA and NIS experience: for use in hot-mix asphalt, for soil stabilization; for flue-gas desulfurization; for use in cement; and slag modification for gravel production. These alternatives were then ranked according to economic and environmental attractiveness. The least expensive of the five alternatives, slag modification, was also perceived as the least risky, as there is already a developed market for gravel in Kazakhstan, and this alternative was selected as the most attractive option for AFP. Unlike the other four alternatives, this option requires a change in the smelting process itself (adding borate ore to the furnace charge) to stabilize the low-carbon slag waste. The stabilized slag waste can then be sold as gravel.

AFP's Vice President and Senior Environmental Manager traveled to the USA on a site visit organized by EnSafe to view US technologies that make use of wastes with similar properties to the low-carbon slag waste generated at Ferrochrome. The group looked at processes which use lime for gypsum wallboard production and fly ash as an additive in cement. While in the USA, EnSafe provided training on environmental risk assessment, including development of a conceptual site model, data collection and sample technology.

Product(s): 1) Alternative uses of low-carbon slag waste developed and ranked; optimal alternative selected for further study. 2) Site visit to the USA to view American experience in utilizing waste and training in environmental risk assessment.

### **4. Pilot Study on Low-Carbon Slag Stabilization**

Action: The selected option, slag modification for gravel production, involves adding borate ore during the smelting process to the furnace to stabilize the slag. Pilot tests were run over the course of seven months evaluating these modifications in the smelting process and on the chemical and physical properties of the modified slag. Using a smelting furnace at AFP, the project team determined the optimal amount of borate ore needed and tested the properties of the modified slag to verify its stability. The pilot study showed that the modified slag waste can be appropriately used for gravel production according to both governmental and health department standards.

Product(s): 1) Evaluation of the selected option under experimental testing.

## **5. Presentation of Project Results**

Action: Project results were presented to in a workshop entitled "Mechanisms for Regulating and Encouraging Natural Resource Protection Activities", held in Almaty, Kazakhstan. The workshop was jointly organized by UNDP and Kazakhstan's Ministry of Natural Resources and Environment. During the workshop, EnSafe representatives gave presentations on environmental risk assessment, impacts of low-carbon slag waste, potential uses for slag waste and project results. Ferrochrome's representatives gave presentations on industrial waste utilization and slag waste utilization at Ferrochrome facilities. The workshop and results of the EcoLinks-funded Ferrochrome project were covered in news articles by Interfax-Kazakhstan and the newspaper Egemin Kazakhstan.

Product(s): 1) Dissemination of project results.

## **Project Benefits**

This project drew on both US and NIS experience in improving the management of AFP's low-carbon slag waste stream and brought about economic, environmental and capacity-building benefits in the process. Through the project, the Leader's capacity to assess and quantify environmental risk was increased and the US Partner gained experience conducting environmental assessments in Kazakhstan. Environmental benefits from the project include a less toxic waste stream and a significant reduction of on-site stored waste. Economic benefits stem from reduced environmental fees for waste storage and from gravel sale.

### **Capacity Building Benefits**

Through this project, the Leader's capacity to assess and quantify environmental risk was developed. Working with their US partner, EnSafe, technical specialists from AFP learned basic concepts of conducting an environmental cost benefit analysis and of quantifying environmental risk.

The US Partner, EnSafe, gained experience in conducting environmental consulting work in Kazakhstan, and an understanding of market demand for environmental services in the country. Following the completion of this project, the US Partner, EnSafe, opened a branch office in Almaty, Kazakhstan. The office currently employs 4 people and offers environmental consulting and engineering design services to government and private industry sectors in Central Asia.

### **Environmental Benefits**

Prior to project implementation, slag waste generated during the smelting process was stored on-site at AFP. This waste has been accumulating since the plant began operations in 1943 and now covers an area of over 475 hectares with 12 million plus tons of waste. Low carbon slag waste decomposes into a fine dust (classified as a third-class hazardous waste) which leaches into ground water and easily becomes airborne. Since AFP facilities and waste storage are located within the city of Aktubinsk in open piles, these waste piles present both an environmental and a public health risk.

- Through the implementation of recommendations developed in this project (adding borate ore to the smelting process), low-carbon slag waste is stabilized (heavy metals are bound),

significantly reducing its potential for air and groundwater contamination. Furthermore, as the stabilized low-carbon slag is also a salable product, the future low-carbon waste stream stored at AFP will be reduced by approximately 70%.

### **Economic Benefits**

Implementation of project recommendations results in economic benefits from two sources. First, adding borate ore to the smelting process stabilizes the low-carbon slag, making it suitable for use as gravel. Gravel in Kazakhstan sells for about \$1.10/ton and AFP estimates that gravel sales will earn AFP \$110,670 per year (net) during 2003.

Second, ecological fees for storage of a carcinogenic waste are expected to significantly decrease. AFP expects to reduce ecological fees by almost \$13,000 in 2003 as a result of low-carbon slag waste stabilization.

## **Lessons Learned**

Lessons learned from this project include the following:

Most NIS industrial producers do not have access to capital to make large investments, even if the investment has a very short pay-back time and high internal rate of return. In this project, for example, the low initial investment needed was the primary factor in selecting the slag modification for gravel production alternative.

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